THE U. S. NAVAL OBSERVATORY

STAR

Volume 8, Number 1 "All the News that Fits, We Print" March, 1998

From The Superintendent:

CAPT Dennis G. Larsen

I hope that everyone had a happy holiday season. I, for one, had too much enjoyment, in the food section. It's good to be back to work on a near normal schedule. The command continues to do an outstanding job in support of DOD and the Navy, though we still need to get the word out about these contributions of our USNO professionals. Maybe our Millennium committee will be a good avenue for this. We are now preparing our FY-98 program review which we will provide to RADM Tobin and his staff. The review includes our view of the future and our needs to meet the ever-increasing requirements. Every department is working at peak efficiency and many people are doing much more than their fair share. My thanks go out to you all for your efforts and I will do my best to explain that your value to the Nation is understood and to ensure that you have the proper resources to continue this excellent work.

In This Issue:

We had our first-ever open Partnership Council meeting, which I think was a success. Although a relatively small number of command personnel attended, those that did had good ideas, comments, and questions. Thank you all for your participation. The main ideas were published in the POW and the minutes should be on our Intranet Web page in the future. We want, and I think have, an organization that is committed to improve the quality of employment for us all. It appears that communication remains one of our shortfalls and we will continue to try to improve it. Please look at the POW and/or the Intranet to see the specific issues that were addressed. RIFs were brought up and I stated that there are no RIFs planned or anticipated in the near future. This can change quickly, but for now it should not be a concern for anyone. I will ensure that we let you all know as soon as possible, if this changes. We reviewed last year's command assessment results. With over 60 percent of the command participating, there were mostly favorable results. Some areas need improvement and not all command members were totally satisfied. This assessment will be our ground truth for the next assessment to be conducted at the end of March. I hope you all take the time to answer the questions openly and honestly, so that we can see where we need to improve our command climate. Several other issues were raised and the Partnership Council will attempt to answer all of them. I think the most immediate concern on many of our minds is regionalization. I wish I could give you answers on this, but we are just getting started in the negotiation phase with Naval District Washington and CNO-09B (our new claimant for facilities and security). So far, two departments will definitely be affected; they are FM and SO. The implementation and negotiating with the above will last at least through June/July before we have a clear picture of what and how this will affect all of us. I do not think that there will be drastic changes the first year, starting 01 October 1998, but thereafter, I just don't know. It depends of the fiscal climate in the Navy and DOD at that time.

We have selected several employees for promotions due to increased workloads and responsibilities. Until the paperwork is completed, I cannot officially announce these selections, but I feel that they were all deserved and want to congratulate you all in advance. Those of you who did not get promoted but were nominated are also doing great jobs, so say your supervisors. Thank you for your efforts and maybe next year will be your turn. Finally, those of you who were not nominated are also doing great work. These promotions were for only the GS-12s and above and for only those that are taking on increased responsibilities which justify a higher pay grade. So please continue to do your jobs in such a great manner. After the next couple of months, we will have a better understanding of the regionalization, the budget/program review results and hopefully the view of our futures. So, until then, keep up the good work and enjoy the remainder of our mild (El Niño) winter and the approaching early spring.

CAPT Dennis G. Larsen

From the Scientific Director:

Dr. Kenneth L. Johnston

Observatory Accomplishments in 1997

It is important to see what we have accomplished in the past year as we set new milestones for the future. Without goals we will most probably accomplish little. The Observatory has three very general goals as outlined in our mission statement. They are to meet DoD needs in the areas of precise time and time interval (PTTI), earth orientation parameters, and the precise position of celestial bodies. Many requirements are met by the day to day operation of the Observatory.

The need for precise time, be it at accuracies of days to a nanosecond, is being met by the Master and Alternate Master Clocks. This is one of the Observatory's major accomplishments in 1997. Operations with GPS have been improved through tuning constants of the GPS Kalman filter. Time transfer accuracy of 8 nanoseconds via GPS is now possible. Two Way Satellite Time Transfer (TWSTT) has expanded to provide precise time to additional high precision users. 1997 saw the initiation of USNO time on SIPRNET giving time to DOD's classified Internet. The STEINTEC measuring system is now operational providing USNO with the capability to measure time at 2ps precision. This improvement will allow an improved understanding of the Master Clock's noise sources, leading to an improvement in time scales. Development of the Cesium fountain has progressed to the point that atoms can now be launched.

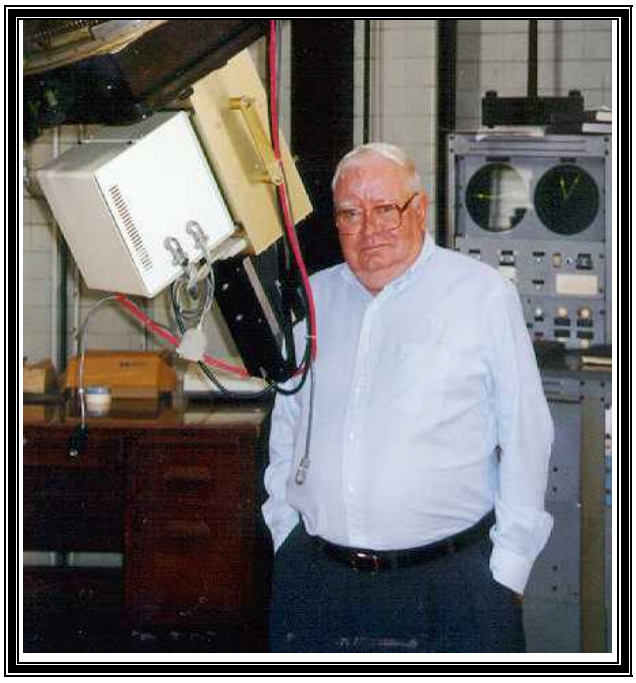
Earth orientation parameters were determined biweekly and are now distributed predominately via the Internet; they are available on servers here at the Observatory. This has saved considerable effort in the mailing of this information and has improved the service by making it more current. The effort to determine UT1 via GPS is progressing well and it appears that estimates of UT1 can be used independently of VLBI for about a week. USNO has now developed the ability to provide precise GPS orbits to the International GPS Service (IGS). A pilot project in cooperation with the International Bureau of Weights and Measures (BIPM) was initiated to investigate the use of GPS carrier phase for high precision time transfer.

In the area of astrometry there are many highlights. The IAU officially adopted the International Celestial Reference Frame (ICRF) based largely on work done at USNO. The radio reference frame program has made great progress in obtaining detailed maps for most the sources making up the ICRF north of -30 degrees declination. A program was initiated using the VLBA in 1997 that will obtain one days observation every other month in order to monitor these sources. The observational programs for parallax using the 61-inch telescope continued; observations of double stars using the 26-inch telescope with the speckle camera; asteroids and satellites with the transit telescope, 26- and 61-inch telescopes have also continued. A major achievement was the completion of the *AC2000* catalog. When combined with the *Hipparcos* and *Tycho* catalogs, the *ACT* catalog, which was prepared in time for the IAU General Assembly, is the preferred reference catalog for all users. It has a million stars down to tenth magnitude. The *USNO A.1* and *SA.1* are the best reference catalogs for users requiring reference stars down to twentieth magnitude.

The Optical/IR interferometer nears completion and will soon start its astrometric mission of determining the positions of bright stars. A major accomplishment in 1997 has been the precise measurement of the limb darkening of stars. Work accomplished in 1996 on the imaging of the binary star Mizar A has been awarded an NRL publication award.

The 1998 *Nautical*, *Air* and *Astronomical Almanacs* were successfully produced. The MICA 1.5 book and disk are now available providing astronomical software up to 2005. The USNO home page site (www.usno.navy.mil) now contains the International Celestial Reference System (ICRS). The NOVAS routines have been expanded to support the ICRS. The PTTI meeting and Astrometry Form were held very successfully. One outstanding presentation at the Astrometry Form was the explanation of the ICRS and the distribution of the *ACT* catalog.

1997 has been a very successful year for the Observatory. We look forward to a great 1998.



CHARLES EDMUND WORLEY, 1935-1997

Geoffrey G. Douglass, Thomas E. Corbin, and Brian D. Mason, Astrometry Department

Charles Worley, 62, Astronomer at the U. S. Naval Observatory, died unexpectedly on Dec. 31, 1997, after a short illness. He was born on May 22, 1935, in Iowa City, Iowa, and grew up in Des Moines where his father was a doctor. He became interested in astronomy at age nine. His first observational work as an amateur astronomer was plotting and recording of more than 10,000 meteors for the American Meteor Society. Continuing his love for astronomy he attended Swarthmore College where he took part in the parallax program. He also met the other love of his life, his wife, Jane. He obtained a B.A. in mathematics from San Jose State College in 1959. He worked for the Lick Observatory in California (1959-1961) as a research astronomer under a Naval Research grant to observe double stars. Since arriving at the U.S. Naval Observatory in 1961, he was the motive force behind an extensive program of double star observation (being, himself, a prolific observer having the second largest number of double star measurements ever achieved by one person), instrumental innovation, and double star cataloging. He quickly gained recognition as one of the world's leading experts in the field of double star astronomy.

In 1965 Charles arranged for the database of double star data, the *Index Catalogue of Visual Double Stars (IDS)*, to be transferred from the Lick Observatory to the USNO. This database has become a truly comprehensive resource under his guidance, and is formally recognized as the international source of double star data by the International Astronomical Union (IAU). He updated the database on a continuing basis adding 290,400 observational records to the original 179,000 and increasing the original 64,000 systems by an additional 17,100 through careful literature searches and extensive communication with other double star observers throughout the world. During the past three years he extended the scope and utility of the database, now known as the *Washington Double Star Catalog (WDS)* by adding accurate photometric data, improved spectral types, and identification information. The project was completed in 1996, and the revised *WDS* is available on the World Wide Web. Most recently he oversaw the addition of 15,000 *Hipparcos Catalog* double stars into the *WDS*. Requests for information from the *WDS* database arrive daily from astronomers all over the world.

In collaboration with William Finsen and later Wulff Heintz, Charles produced two *Catalogs of Orbits*

of Visual Binary Stars, the most recent published in 1983. At the time of his death he was preparing what would have been a new version.

In recent years an accurate knowledge of double and multiple star separations, position angles, and orbital motions has become increasingly important to astronomy. It is now realized that not only must double stars be identified and calibrated in order to produce the best astrometric catalogs of stellar positions, but also the varying centers of emission at different wavelength bands must be taken into account to meet modern high-precision astrometric needs. For Charles's contribution to this aspect of astrometry, he received the 1994 U.S. Naval Observatory Simon Newcomb Award for Scientific Research Achievement.

In 1991 he was elected as vice-president of Commission 26 of the IAU (Multiple & Double Stars) and became president of that commission at the IAU General Assembly in 1994. He was a member of IAU Commission 5, the American Astronomical Society, including the AAS Historical Astronomy Division, and the Royal Astronomical Society. He was also an active supporter of the amateur community, and published a series of articles in *Sky and Telescope* and produced the double star section of the annual RASC *Observer's Handbook*.

During his career Charles made over 40,000 measures of double and multiple stars using the USNO filar micrometer on telescopes in the northern and southern hemispheres. In 1990 he obtained a speckle interferometer in order to improve the accuracy of double star measurements. During the past seven years he oversaw improvements in both instrumentation and software implementation that resulted in making the USNO the world's second largest producer of double star observations using a speckle interferometer. Under Charles's direction more than 9,200 observations were made with the speckle interferometer on 1,100 systems down to separations of one-fifth of an arcsecond, the theoretical limit of the 26-inch refractor. Recently the speckle interferometer has been used to observe Hipparcos problem stars on the McDonald 2.1-m Otto Struve telescope. His special interest in nearby stars led to the discovery of 39 new, cool stellar companions. These companions which are faint and difficult to observe provide critical census information on the solar neighborhood. From 1954 to 1997 he published some 75 professional papers primarily on double star astronomy and gave numerous invited presentations at meetings. He was known for exacting standards and high quality best typified by his paper challenging all other double star observers; "Is This Orbit Really Necessary?"

We are reminded of a favorite quote of Charles' from Paul Couteau's book *Observing Visual Double Stars*:

> "Do not forget that an astronomer who observes perfect images visually is a wild beast who devours his prey. Do not disturb him under any pretext. Let nature take its course".

Charles will be sorely missed by his many friends and colleagues.

4-Beam Launch Realized in Observatory's Cesium Fountain Project

Dr. Eric Burt, Time Service Department

The cesium fountain being built at the observatory has reached two new milestones in the last month. As reported in the previous issue of the *Star*, Chris Ekstrom and I had successfully isolated and cooled atoms in a Magneto-Optic Trap (MOT). Since then, we have further cooled atoms to less than 4 μK (millionths of a degree above absolute zero) - very close to our ultimate goal of 2 μK. In a general sense, colder atoms move slower. Therefore, this reduction in atom temperature is necessary to prevent the cloud of atoms from spreading out too much as they are launched up in their fountain trajectories. These lower temperatures were achieved by optimizing what is referred to as an "optical molasses" - a combination of laser intensities and frequencies that selectively pushes on fast atoms in a direction opposite to their direction of motion, thereby always slowing them down (making them colder).

The second milestone was the achievement of a "4-beam lattice launch". To create a fountain, we must first cool the atoms and then launch them upward to a height of about 1 meter. The launching is achieved by creating a slight imbalance in opposing

laser beams that push on the atoms such that a net upward force exists. In principle this can be done with just 2 beams - one going up and the other going down. While this is the simplest approach it has the disadvantage that it will tend to heat the atoms in the two horizontal directions. There are two conventional approaches to this problem. One adds a second set of beams to cool atoms in the horizontal plane *after* the launch has taken place. The other would have a set of 6 beams on during the launch: 2 to launch and 4 orthogonal beams to keep the horizontal dimensions cool. A two-beam launch with additional horizontal cooling is cumbersome because it involves cooling the atoms, heating them, and finally cooling them again. It would be more efficient to keep them cool through the entire process. A 6-beam launch achieves this goal, but is over-constrained. The same effect can be accomplished with 4 beams using the right geometry. We have been able to get this 4-beam launch to work. We are able to launch atoms with velocities that will carry them easily above the 1-2 meters required, and we have been able to launch atoms to lower heights while still maintaining cold temperatures. We are currently assembling some enhancements to the experiment that should allow us to get both high launches with cold temperatures *simultaneously*. This work represents the first time that a 4-beam launch has been demonstrated. The 4-beam launch technique should prove to be not only a useful tool for our fountain, but a fascinating way in which to study atoms at ultra-cold temperatures.

The USNO Millennium Committee

Steven J. Dick, Public Affairs Office

As part of the White House Millennium Project, the USNO has established the USNO Millennium Committee. The overall idea of the program is to reflect on the past while planning for the future, to showcase the achievements that define us as a nation (including scientific work), and to prepare for the new century and millennium in creative ways.

Because the millennium is related to time, the Naval Observatory is in a unique position to join in the millennium celebration with aspects related to time and navigation. USNO dropped the first time ball in 1845 from its Foggy Bottom site, disseminated telegraph time beginning in 1866, sent the first radio time signals in 1902, continues to disseminate time via GPS, and so on.

Among the ideas so far for USNO millennium celebration are 1) drop a time ball, both on New Year's Eve 1999 and New Year's Eve 2000. (The White House countdown is to the "Millennial Year" beginning Jan. 1, 2000, but they recognize (citing USNO!) that the millennium begins Jan 1, 2001). The likely location for the drop would be the top of Building 1, near the 12-inch dome. It might also be possible, via time transfer, to drop one at the original Foggy Bottom site. Tying this to the 1845 event would emphasize the idea of the USNO as the nation's first timekeeper. 2) Erect a countdown clock at the front gate that would count down to 2000, then 2001. Another might be erected on the Mall. 3) Have a one-day Symposium on the occasion of the 150th anniversary of the founding of the Nautical Almanac Office, established by the Naval Appropriations Act of March 3, 1849. Such a Symposium would emphasize both history and current mission. 4) Numerous smaller projects, including establishing a USNO Millennium Web Page with FAQs related to the millennium; issuing a series of press releases on the USNO's role in time determination and dissemination, and devising ways to give the public a feel for "1000" years in astronomical terms.

The members of the committee are Steve Dick (Chair), Geoff Chester (PAO), Alan Fey (EO), Annette Hammond (DS), Mihran Miranian (TS), Ted Rafferty (AD) and Susan Stewart (AA), with input from FM and the Instrument shop. We hope other staff members will cooperate as asked. Anyone with further ideas should contact a committee member.

For more on the White House Millennium Program see the web site at (http://www.whitehouse.gov/Initiatives/Millennium/main.html), where the Naval Observatory is already mentioned as "the nation's official timekeeper".

Status of a minor planet discovered at USNO

Jim DeYoung, Time Service Department

On April 19, 1993 a new minor planet was discovered using the 24-inch telescope and 1K x 1K CCD at USNO. Jim Rohde (currently in EO) and I were taking Kron-Cousins R-band images of the outer satellite of Jupiter (XII) Ananke for the purpose of measuring astrometric positions. Short exposure images were taken with the intent of co-adding them at the expected rate of motion of Ananke. This was done, and the very small 19-20th magnitude moon showed up beautifully. Inspection of the images showed the star streaks at the expected position angle, but one streak was at a different angle indicating a different motion on the sky. Several days had elapsed since the original exposures, so now the job became to extrapolate its motion forward and go search.

Five days after the first Ananke images were taken we had clear weather. Rich Schmidt and I searched the region where we expected to find the suspected object. I was about to give up the search and go on to something more profitable, but Rich said "You should search more around the area." Within minutes a short streak was found. Astrometric positions were measured from the CCD images from the two nights and were reported to the Minor Planet Center (Brian Marsden) to claim our discovery. An email quickly returned from Brian allocating the provisional name 1993 HG.

Now my job was to continue to observe the faint object in order to improve its orbit to have any chance of finding it in future months and oppositions. The minor planet by now was beginning to fade after opposition. A total of 60 astrometry positions were made by USNO-DC between April 19 and June 24, 1993. With so many positions, the orbit should have been well known. I searched the following opposition for 1993 HG and never found it. It would have been pretty far south and probably was not found due to its faintness, non-perihelic opposition, and the bright skies of Washington. I thought the object was lost since it wasn't picked up at the next opposition.

On March 9, 1998 I logged onto the CBAT computer system at Harvard to check some orbital elements of several Near-Earth-Objects (NEOs). I decided to check 1993 HG one last time, since I knew it should have completed another full orbit and would be near where it was discovered and at an expected magnitude of 17.5-18.0 or so at opposition. To my great surprise I saw that the elements had changed, which indicated recent observations had been made. These follow-up observations were made by Marc Buie at Lowell Observatory, Flagstaff, AZ during the first weeks of 1998. Two oppositions have now been observed, but in order to name a new minor planet, three oppositions must be recorded.

The orbital elements have changed slightly. When the object has been observed at its third opposition in the future the discoverer will be afforded the right to name the object. Names are being considered in order to be prepared! The current orbital elements by Gareth Williams at the Minor Planet Center are attached with a plot of the Earth-Jupiter rotating-frame view integrated about 140 years into the future with Mercury through Neptune considered for perturbations. 1993 HG is near the 2:1 resonance with Jupiter.

1993 HG = 1993 FO42

Epoch 1998 Dec. 18.0 TT = JDT 2450800.5				Williams	
M	279.14458	(2000.0)		P	Q
N	0.17705976	Arg.	183.58391	-0.70008150	+0.71388207
a	3.1409146	Node	41.98351	-0.65454109	-0.63256640
e	0.1456345	i	1.37671	-0.28541524	-0.30038666
P	5.57	H	13.5	G 0.15	U 5

from 72 observations 1993 Mar. 19-1998, Jan. 8

Two Asteroids named in Honor of USNO Staff Members

(7011) Worley = 1987 SK_1

Discovered 1987 Sept. 21 by E. Bowell at the Anderson Mesa Station of the Lowell Observatory.

Named in memory of Charles Edmund Worley (1935-1997), indefatigable observer and cataloguer of double-star positions. Following two years at the Lick Observatory, he was on the staff of the U.S. Naval Observatory from 1961. His work has significantly enhanced our knowledge of the motion of double-star and multiple-star systems and of stellar masses. Name suggested by H. Eichhorn.

Minor Planet Circular 31296, 1998 Feb. 11

(4008) Corbin = 1977 BY

Discovered 1977 Jan. 22 at the Carlos U. Cesco Station of the Felix Aguilar Observatory.

Named in honor of Thomas E. Corbin, head of the Meridian Circle Division at the U.S. Naval Observatory, and his wife, Brenda Groves Corbin, since 1973 the Observatory's librarian. Serving early in his career as astronomer-in-charge of the Observatory's southern station in Argentina, Tom Corbin has since been responsible for several important astrometric programs, including the Astrographic Catalogue Reference Stars catalogue. Brenda Corbin is one of the most renowned astronomical librarians in the world, known for her work in the Special Libraries Association, the IAU Commission 5 Working Group on Nomenclature and for her enthusiasm in tracking down copies of rare works.

Minor Planet Circular 31295, 1998 Feb. 11

The *AC 2000* and *ACT* *Reference Catalog*

Sean Urban, Astrometry Department

The Astrometry Department has recently released two catalogs, the *AC 2000* and the *ACT Reference Catalog*. The *AC 2000* is a positional catalog, with no proper motions, of 4.6 million stars down to about visual magnitude 12.5. The *ACT* contains positions and motions of 988,758 *Tycho* stars. Both catalogs are currently available on CD-ROM by contacting me (seu@pyxis.usno.navy.mil) or can be accessed via the WWW (http://aries.usno.navy.mil/ad/ac.html and http://aries.usno.navy.mil/ad/*ACT*.html).

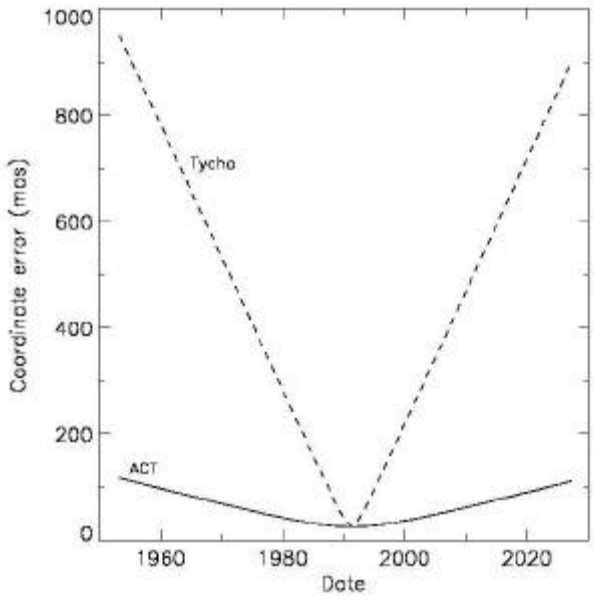
The *AC 2000* is a positional catalog of 4.6 million stars on the ICRS system for the epochs of observation. Many people at USNO were involved in the production of this catalog; a list can be found in the August 1997 *STAR* where this project was last described. To summarize the project, the data in the *AC 2000* are from the measures published as the *Astrographic Catalogue (AC)*, which was an international effort designed to photograph and measure the positions of all stars brighter than magnitude 11.0. This magnitude goal was often exceeded on the faint end, but many of the brightest stars were not measured because their images were over-exposed on the photographic plates. This project was started over 100 years ago; the average epoch of an *AC* plate is 1905. By itself, the *AC 2000* has limited use, since most people do not care where 4.6 million stars were in 1905. However, when combined with new observations, one can easily calculate how the stars are moving with time. This "proper motion" is extremely important to astronomers and to the Navy. Astronomers need accurate proper motions for things ranging from studying the structure and dynamics of the Milky Way to predicting asteroid occultation events. The Navy and other DoD agencies utilize accurate proper motions to precisely predict where stars will be at any time, which is very important to many navigational systems. The better the proper motions, the better one is able to predict a star's position. The history of the *Astrographic Catalogue* is quite interesting. An article by myself and Tom Corbin describing some of its history as well as the USNO's role is scheduled to appear in the June 1998 issue of *Sky and Telescope.*

As stated above, the real strength of the *AC 2000* catalog is shown when its positions are combined with new observations of the same stars. Gary Wycoff, Tom Corbin and myself did just that to create the *ACT Reference Catalog*. We combined the *AC 2000* positions with the *Tycho* catalog positions to derive accurate proper motions for the majority of the *Tycho* stars. The *Tycho* catalog contains very good positions at the date 1991.25 for slightly over one million stars observed with the Hipparcos satellite. Knowing star positions in 1905 and in 1991.25 allows us to accurately determine how fast and in which directions the stars are moving; these are known as proper motions. It is important to note that the *Tycho* catalog does contain proper motions, but they are about a factor of 10 worse than those in the *ACT*.

Figure 1 (see next page) shows the positional accuracy of a typical star from the two catalogs with time. At date 1991.25, the positions are very well known since this is the *Tycho* date of observation. Before and after that date, the computed proper motions become important in predicting the location of a star. It is obvious from that graph that a typical *Tycho* star's accuracy, with a good position but poor proper motion, deteriorates much more rapidly than the same star in *ACT*. In addition to the astrometric

data, the *ACT* catalog includes photometric data (B and V) from *Tycho.* Also, cross references to the *Tycho*, *AC 2000*, *Bonner Durchmusterung (BD)*, *Cordoba Durchmusterung (CD)*, *Cape Durchmusterung (CPD)*, *Henry Draper (HD)*, and Hipparcos Catalogues are given.

Figure 1



The *ACT Reference Catalog* has only been available for a few months, but it is already making an impact at USNO and other institutions. Dave Monet is utilizing it for his new reductions of the Palomar Sky Survey and its sister programs. Ron Stone is using the data for his reductions of the 8" automatic transit telescope (FASTT) observations. Norbert Zacharias is reducing the data from our Southern Hemisphere observations (UCAC-S) primarily with *ACT*. And Jeff Pier, Greg Hennessey, and Bob Hindsley will be using *ACT* for the astrometric pipeline of the Sloan Digital Sky Survey. In addition to these USNO programs, Jet Propulsion Lab is using the *ACT* in their navigation of the NEAR spacecraft, and plans to use it in the New Millennium Deep Space One probe to be launched in July. These are some of the projects currently benefiting from this catalog; many more will certainly follow.

The Astrometry Department is currently working on projects that will eventually make even the *ACT* catalog obsolete. We hope to make new reductions of the *AC* data with a better reference catalog than the *ACRS*, which was used in the initial reductions. We can improve upon the *ACRS* by utilizing data made available in the last few years. We can combine the new AC positions not only with the *Tycho* catalog as was done in creating the *ACT*, but also with additional observations from the UCAC-S and Twin Astrograph Catalog programs. The catalog resulting from these steps will have more stars with better accuracies than the *ACT*. However, for at least the next few years the *AC 2000* and the *ACT* will continue to play a significant role in many projects and investigations. They represent a large step forward in the continuing process of determining more precise positions for more stars to meet the needs of the astronomical community and the Department of Defense.

INTEREST IN USNO INTERNET TIME IS BOOMING

Richard Schmidt, Time Service Department

The Time Service Dept. is serving up Internet time in a big way. Since the establishment of USNO Network Time Protocol (NTP) synchronization service in May, 1994, Time Service has become the world's foremost provider of accurate and reliable time on the Internet. Fourteen USNO NTP servers from coast to coast now respond to over 250 million hits per month.

NTP has been described as the most widely available, longest running protocol on the Internet. It is designed to provide time synchronization among computers at the submillisecond level on LANs and in the low tens of milliseconds over wide area networks. NTP client/server software has been ported to virtually every computing platform from Windows PCs to supercomputers.

USNO provides the top level or "stratum 1" NTP service using industrial workstations which are fed time signals from our Master Clocks in Washington and at the Alternate Master Clock facility at Falcon, Colorado. The four atomic servers alone respond to over 160 million timing requests per month, a number that is growing at about 400% per year. Computers love USNO time! All remote USNO NTP servers synchronize to internal GPS receivers. The first of these systems, at Washington University in St. Louis (established Dec. 1995), is also the busiest, currently handling over 15 million NTP packet requests per month. USNO also maintains

NTP servers at UCLA, Georgia Institute of Technology, Columbia University, MIT, the University of Washington, Seattle, University of Houston, Digital Equipment Corp. Palo Alto, and OARnet, Columbus. Alaska and Hawaii are planned expansion sites. Using GPS as the medium for distributing USNO Master Clock time, this widely dispersed ensemble of time servers is designed to reach most users with a minimum of network hops.

USNO's NTP clients include all branches of the military and of Federal, State, and local governments, and major contractors and corporations, media, and network and telecommunications companies. Because international Internet links are now very fast, a growing number of international clients are looking to the USNO for NTP service.

Recently Time Service has expanded NTP service to the classified DoD SIPRNET. The SIPRNET has extended its hub network directly into the AMC at Falcon and into Time Service in Washington. SIPRNET NTP servers send and receive NTP packets through a keyed KIV-7HS encryption device operating 24 hours a day (or 86400000000000 nanoseconds per day!) Time Service is currently designing a remote SIPRNET NTP server that will feature dual PPS GPS receivers in a VMEbus form factor. PPS receivers are protected against GPS anti-spoofing. The Defense Information Systems Agency has contracted with USNO for installation of two of these servers to be placed at DISA hub sites in Germany and in Hawaii, the first of a future global network of NTP servers. Driving this effort is a new release of the DISA Global Command and Communications System (GCCS), a tactical war-fighting network.

USNO work on this project will include procurement, integration, testing and calibration of a new GPS VME product using the Miniature PLGR GPS module, and production of software device drivers and integration into the new NTP release 4. USNO will monitor remote SIPRNET servers from its node here in Time Service.

Eclipse Roundup: USNO Staff Experiences with the 26 February Event

The February 1998 Total Solar Eclipse from Aruba

George Kaplan, Astronomical Applications Department

Over two years ago, a group of U.S. Naval Observatory staff members began planning to observe the total eclipse of the Sun that would be visible from parts of the Caribbean and elsewhere on 26 February 1998. Total solar eclipses happen somewhere every year or two, but many occur in remote, inconvenient places. Caribbean islands are easily accessible by air and are very accommodating to tourists. Besides, February is a good month to leave Washington and hit the beach!

Some of us had seen one or more total eclipses before, others not. Most people who have seen one feel compelled to see another. They are perhaps nature's most spectacular and beautiful event, turning day into night for a precious few minutes as the Moon passes directly in front of the Sun. Each one is a magnificent light show, played out in silence, choreographed by gravity. When I saw my first total eclipse in 1970, I understood why primitive peoples feared them -- the phenomena are so all-encompassing, it is easy to imagine the world coming to an end.

For the February eclipse, four USNO staff members, John Bangert, Merri Sue Carter, Geoff Chester, and Jim Clark, were on eclipse cruises that sailed into the path of totality. (This is a popular way of seeing an eclipse since ships can respond to weather conditions and move to clear areas.) Dennis McCarthy was on the island of Antigua in the northeastern Caribbean. This story is about the five staff members -- Lee Breakiron, Christian Hummel, George Kaplan, Kerry Kingham, and Marc Murison - who went to Aruba along with assorted spouses and friends. Aruba is a small Dutch island just off the coast of Venezuela. We originally became interested in Aruba and its sister island, Curacao, when we heard about the very arid climate there and the excellent prospects for clear skies.

We were part of a large excursion arranged by a travel agency in Annapolis. (The travel was not official; we were all on leave and we paid our own way.) The technical advisor for the trip was Dr. Jim Huddle, a physics professor at the Naval Academy.

The eclipse was on a Thursday, and we flew into Aruba on Monday night (actually, Christian and his wife, along with my suitcases, didn't arrive until Tuesday). We were somewhat concerned to find that although Aruba is in fact a desert island, with cactus everywhere, the skies were often full of fair-weather cumulus clouds. There seemed to be a significant cloud buildup each day in late morning that largely dissipated by early afternoon.

Eclipse time was to be just after 14:00, so we were hopeful. On the other hand, the cooling effect of eclipses sometimes does unpredictable things to the weather, so there was still plenty to worry about. Another problem was the near-constant 20-knot trade winds that blow across the island from the east, which can shake telescopes and cameras.

We had decided to watch the eclipse from the beach by our hotel (and not far from the bar!). Many people were going to travel to the southeast end of the island where there was to be 30 extra seconds of totality. We saw no need to get involved in the traffic and the crowd there; besides, we had noticed that the cloudiness always seemed worse to the south.

On Thursday, eclipse day, by around noon, the dreaded clouds were as bad as they had ever been. At one point it was almost entirely overcast. We heard that it actually rained a bit down on the southeast end of the island where so many people had gone. But what the trade winds bring, they also take away, and within about a half-hour large areas of blue sky were opening up. After about 13:00 the Sun was very seldom covered by a cloud, and what clouds there were in the sky were small and on the move.

We had set up on the narrow beach behind our hotel, using one of the hotel towers as a windbreak. (Lee and his wife were near the hotel pool.) There were plenty of other people on the beach, of course, but it never became the crowded human zoo we wanted so much to avoid. With the sea and sand and palm trees, it was a great location to watch an eclipse.

The slow, early stages of the eclipse were themselves undramatic. We had come armed with specific calculations for our location computed by John Bangert and, since we had set our watches by the USNO Master Clock before we left, we knew exactly when events would occur. Totality would begin at 14:09:54 and end at 14:12:50. As the Moon covered more and more of the Sun, the edges of shadows became very sharp. Little crescents of light appeared under trees and bushes -- these were pinhole images of the partially-eclipsed Sun. The wind died down. It was not until perhaps 10 minutes before totality, with the Sun 90% covered by the Moon, that the ambient sunlight began to appear noticeably dim and the world took on a strange half-lit appearance. As one of our group, Neville Withington, said at the time, "the light is definitely looking funky".

But not nearly as funky as it would get! About 30 seconds before totality, a dark band appeared in the sky along the southwestern horizon over the sea -- the Moon's shadow approaching. As the blue sky darkened, the planet Venus appeared near a cloud. Within a few seconds there was only a small bead of sunlight left, and before the Moon covered it entirely, the Sun's tenuous outer atmosphere, the corona, appeared. As the last rays from the Sun's surface disappeared behind the Moon, the planets Mercury and Jupiter popped into view in the deep twilight sky near the Sun. Totality! The full glory of the Sun's corona was revealed: wispy white filaments radiating outward from the black disk of the Moon, following the magnetic field lines of the Sun like iron filings near a bar magnet. As we all held our breath, a small cloud drifted over the Sun for about five seconds before going on its way. Through a telescope, solar prominences could be seen protruding from the edge of the Moon's limb. We had less than three minutes to gape in awe at all that could be seen, to try to pull what we were experiencing into our memories. And, at the same time, to try to retain enough presence of mind to take a few pictures!

I knew totality was about to end when I saw, through my little telescope, the pink edge of the Sun's chromosphere appear on the right side of the Moon's limb. The chromosphere is just above the photo-sphere, the brilliant face of the Sun we normally see, so it was time to take my eye away from the telescope! Totality ended as a bright spot of sunlight appeared

from behind the Moon, dispersing the darkness, the corona, and the planets.

At the beach, we did not see the strange "shadow bands", wave-like ripples of light that often move across the ground just before or after totality. Lee, near the pool, did report seeing them. Dennis McCarthy, who saw the eclipse on Antigua, said they were spectacular there.

Of course, after totality, the final stages of the eclipse are quite anticlimactic, and few people actually stayed around to the very end.

It is appropriate to close this story with a quote from Marielsa Croes, a native of Aruba: "We saw an amazing thing yesterday. We saw the complete solar eclipse at 2 p.m. in Aruba. It was gorgeous and you get chills all over your body. The birds flew away ready to depart as the flowers closed as if it were night. Other animals became slightly nervous and we just sat there with our mouths open in darkness for three minutes in the middle of the day. In Venezuela people stood with their hands open at the moment of total eclipse to catch the powerful and divine silver rays of the sun. We in Aruba smiled, felt so small and admired the beauty of nature. Most feel changed forever."

SeaQuest: Eclipse 1998 from the ms Ryndam

Merri Sue Carter, Earth Orientation Department

John Bangert (and family), Jim Clark and I opted to observe the total solar eclipse of February 26, 1998 from the deck of Holland-America Line's cruise ship, the *ms Ryndam*. After careful consideration we determined that: a) there would be room enough for equipment and observers, b) the ship would be steady enough to permit successful observations, c) the mobility of the ship would ALMOST guarantee clear skies and unobstructed viewing, and d) we would have a FANTASTIC vacation to boot!

Total eclipse was to occur around 2:30 p.m. local time with the Sun at a relatively high altitude, so the fear of ship-based obstructions was minimal. We were scheduled to view the event tucked snugly within the Caribbean islands of Guadeloupe, Montserrat, and Antigua. However, fear of afternoon cloud build-up drove the ship's captain to alter our course along the center line south and west away from any troublesome land masses. Fortified with both a substantial breakfast and a generous lunch, we made our way out to the ample deck space and cheered at first contact. The speed of the ship had been cut to a near stop and we made preliminary temperature measurements, GPS position readings, and scoured the horizon for clouds. The temperature at the beginning of the eclipse was about 86 degrees, the ship was located at approximately 15º 44' north latitude, 63º 27' west longitude, and the cloud cover was ZERO!

As totality neared, the sky darkened and our brilliant neighbor Venus popped out for a rare afternoon visit. The Moon's dark shadow zoomed across the ocean towards us and the shadow bands appeared prominently against the stark white paint of the ship's superstructure. The slim crescent of the Sun gave way to a few Bailey's Beads and then a fantastic diamond ring. The diamond eventually turned to a glowing ruby as the chromosphere became visible. Immediately we abandoned our viewing shields to witness the glorious corona, a fabulous wispy jewel anchored between stunning Mercury and phenomenal Jupiter.

A remarkable amount of fine structure was visible in the corona. Our three and a quarter minutes of totality were dedicated to simply gazing in wonder at this rare and beautiful natural event. Totality was over far too soon, and we scrambled to witness the same sequence of events in reverse order as the Moon's shadow gradually left us.

No movie, still photograph, painting, drawing, poem, song, or words could ever begin to describe the beauty of a total solar eclipse. It simply must be seen in person.

Viewing the eclipse was the primary goal of our trip, however we were blessed with a wonderful vacation as well! St. Martin, Barbados, Guadeloupe, St. Thomas and St. John, and Half Moon Cay (in the Bahamas) were all highlights of this trip. Scuba, eating, snorkeling, sailing, eating, hiking, shopping, eating, swimming, and eating were just some of the activities we enjoyed. The Bangert family put a new spin on the old game of Trivial Pursuit, while Jim and Merri Sue made friends with the local fish. Our

biggest worry was whether we should have the steak or the lobster at dinner, and of course, you could always just get both! We witnessed the "green flash", many meteors, the Southern Cross against an incredibly dark sky, and John was treated to a rocket launch. The final report from the *ms Ryndam* was clear skies and smooth sailing...our total eclipse expedition was a total success!

John Bangert gets keelhauled before the eclipse!

Eclipse at Sea: The view from the ms Statendam

Geoff Chester, Public Affairs Office

In July, 1991 I was fortunate to find myself working as an "Astronomy Enrichment Resource" person for Scientific Expeditions, Ltd.'s eclipse cruise aboard the *SS Constitution,* then the flagship of American-Hawaii Cruise Lines. After making a last-minute 100-mile dash for clear skies (which we successfully accomplished before the start of the eclipse) I became convinced that seeing a total solar eclipse from a cruise ship had some definite advantages.

When the call came from Leif Robinson of *Sky & Telescope* to be a part of the Enrichment staff aboard Holland America Lines' *ms Statendam* for the February 26, 1998 eclipse, I did not hesitate to answer, especially since the opportunity existed to bring my family along.

We sailed from Ft. Lauderdale, Florida at dusk on the 21st. We soon settled into shipboard life, which for me entailed being visible for 16 hours a day to answer questions, giving formal lectures on safe eclipse viewing/photographing/videotaping, and conducting nightly star-watch programs from the ship's Sky Deck. Two days' cruising brought us to the environs of the Netherlands Antillies (Aruba, Bonaire, and Curaçao), where we planned to rendezvous with the Moon's shadow on the 26th.

I had managed to make arrangements to have Sue Palka, well-known Fox-TV weather personality from the DC area, meet us in Bonaire to be on board the ship for the eclipse. Sue duly appeared on schedule, and we slipped into the dusk of the 25th, confident that we would taste success in our quest.

Until the next morning!! The 26th found us off the west coast of Curaçao under overcast skies. The decks were wet from the first rain the island had seen in three months! I had the dubious duty to lecture the ship's 1200 passengers that morning, and it was with some trepidation that I talked about the wonderful event we were all going to be seeing shortly! By the time I finished the program, however, the skies were clearing in earnest.

We took up our station just off the northern tip of Curaçao as first contact occurred. There were still a few clouds dancing around, but as the partial phases progressed, these rapidly dissipated. With 30 minutes to go before totality, the skies became cloudless; the collective sigh of relief from 1200 people was probably heard on the island! As more of the Sun disappeared behind the Moon, shadows became sharper and the ambient light began to suffuse into a rose-tinted glow as red light from the solar chromosphere began to predominate. About 10 minutes before totality Venus appeared in the graying western sky.

Totality rushed at us from the southwest. We could clearly see the approaching shadow darkening the horizon haze layer like a fast-approaching squall line. As the last crescent of solar photosphere shortened to a point, we were treated to a Diamond Ring that seemed to persist for about 15 seconds before the darkness overwhelmed us and the corona appeared, framed by the bright glimmers of Mercury and Jupiter. The crowd on deck let out a huge cheer as the corona became more well-defined with dark-

adapted eyes. Someone noticed that the streetlights in the town of Sabana Westpunt, half a mile to our southeast, had all come on. Over the cheering of the crowd I could hear Sue Palka and her cameraman Nelson Jones repeating "Oh, my God!" over and over again.

And what a corona it was! As I peered through the viewfinder of my camera (attached to my 14-cm rich-field telescope) I was struck by the detail in the polar regions, where short "jets" were clearly defined by the solar magnetic field, and the broad streamers from the southwest quadrant. A large ruby prominence lay on the eastern limb as well. I shot some video footage, took a few pictures through the telescope, but mostly just gaped at the spectacle as the crowd became almost silent. This was my fifth total eclipse, but the weather, the framing planets, and the setting made this one the best!

26 February 1998, 1813 UTC: Totality from the deck of the* ms Statendam*, as seen through Geoff Chester's 14-cm Schmidt Newtonian telescope.

After 3 minutes and 37 seconds, it was over. Another great cheer went up as the shadow raced off to the northeast (reaching the *ms Ryndam* some 20 minutes later). Champagne corks erupted, and 1200 very happy eclipse chasers reveled in the returning sunlight. As we set a course for Willemstad, I asked my 11 year-old daughter Abby what she thought of the spectacle. Never at a loss for words, she found herself (for the first time since age two) completely speechless.

And people still wonder why I chose astronomy as a career...

Security News

Officers Levi Gray Jr, Nadell I. Scott and James W. Waters have completed 40 hours of Phase II, In-Service training (2 - 6 Feb 98). Thanks goes out to Mr. Gary Freeman of National Institue of Health (NIH) for his asking the USNO police to participate in their In-Service Training program.

Officers Leonard A. Golden Jr. and Jerry L. Whitfield are attending 40 hours of Phase II, In-Service training (23 - 27 Feb 98) currently on-going at the Washington Navy Yard. Thanks to the NDW police!

Welcome aboard to Officers Matthew J. Babcock and Robert S. Dyer. Upon completion of their 2 weeks of indoctrination training, both officers will be reassigned to the 2nd shift (1445 - 2315).

USNO POLICE EMERGENCY NUMBERS

34th Street Gate (24 Hours): 762-1468

Shift Lieutenant: 762-0336

Shift Sergeant: 762-0338

Local Emergency Number: Dial 99 + 911.

When calling the local emergency number please notify the USNO police in order to escort the emergency personnel and vehicles to the scene.

GATES (Hours of Operation):

34th Street Gate: Open 24 Hours/7 Days Per Week

South Gate: Open Monday through Friday, 0545 - 1830

Wisconsin Gate: Open Monday - Friday, 0715 - 0900 and 1530 - 1900

Wisconsin Turnstile: 24 Hours Daily (Must have USNO Swipe Card to re-enter)

Davis Street Gate: Closed

Gilliss Avenue Gate: Opened as Directed, otherwise closed

USNO
H*A*P*P*E*N*I*N*G*S
Promotions and Awards

(Above) Superintendent CAPT Dennis Larsen pins the Defense Meritorious Service Medal on XO CDR Mark Gunzelman

(Below) CAPT Larsen presents IC1(SW) Jerry Carillo with the 1997 USNO "Sailor of the Year" award. Congratulations, Jerry!

USNO
H*A*P*P*E*N*I*N*G*S
Promotions and awards

CAPT Larsen and Kathy Roth add a new stripe to the shoulders of LCDR Mike Roth (FM)

LT Teddy Rosaya (RM) receives his new stripe from CAPT Larsen and XO CDR Gunzelman

USNO
H*A*P*P*E*N*I*N*G*S
Hail & Farewell

ET1 Pat Roberds receives his Navy and Marine Corps Commendation Medal from the CO

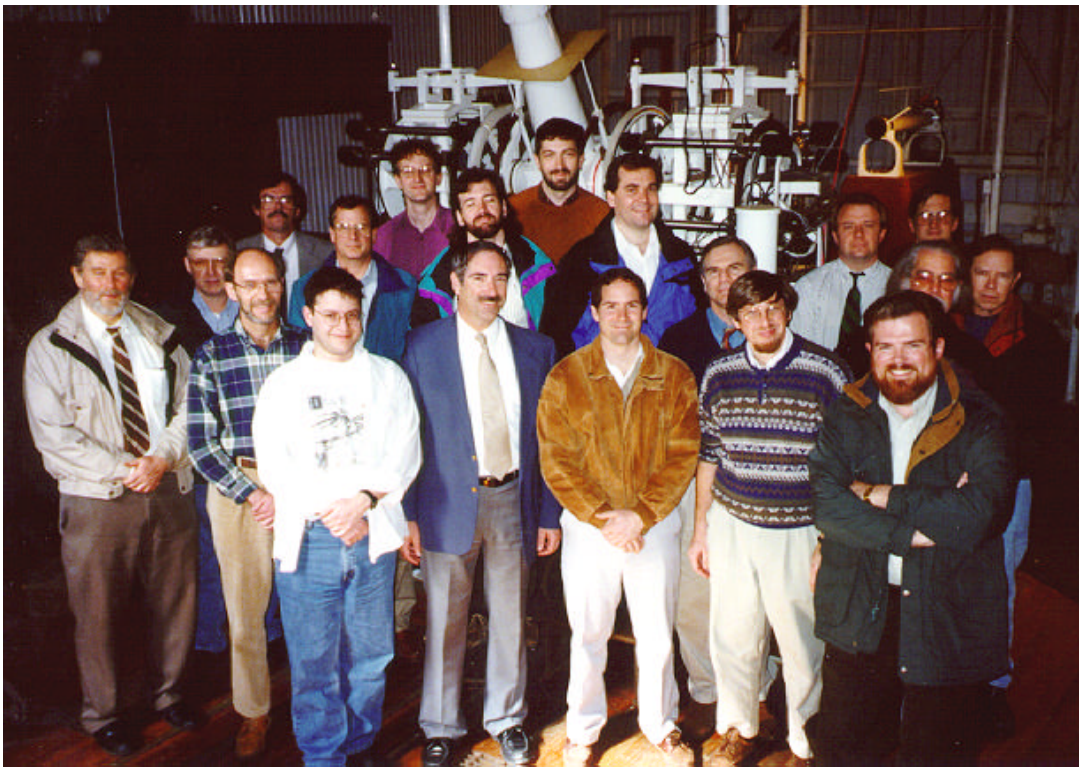
Pat speaks at his farewell luncheon. He's off to Norfolk, and we wish the best for him and his family!
(photo by Jerry O'Neil)

USNO
H*A*P*P*E*N*I*N*G*S
USNO Christmas Party

The 1997 USNO Christmas party took place in the Lobby and Library of Building 1. Over 140 past and present USNO Staff enjoyed the fine food of the "Star Gazer Cafe" (above, left), and the traditional visit by Santa Claus (below, right). The faces at left say all that needs to be said!

(Above, right) Former Scientific Directors Kaj Aa. Strand (1963 - 1977) and Gart Westerhout (1977 - 1993) with current SD Ken Johnston.

H*A*P*P*E*N*I*N*G*S



USNO's 6-inch Warner & Swasey Transit Circle Telescope celebrated its Centennial on 14 February. On hand to mark the occasion, members of the Astrometry Department pose with the historic instrument. Although regular use of the telescope ceased in 1995, AD astronomer Ted Rafferty made a few observations on 15 February to extend its use to "over a Century!" Nearly one million program observations were made with the telescope during its long career.

Staff members who couldn't make the journey south to the total solar eclipse of 26 February viewed the 22% partial eclipse through the eyepiece of the 12-inch telescope in Building 1. (Photo by Alan Fey)

ABSTRACTS OF RECENT PAPERS:

The 488,006,860 Stars in the USNO-A1.0 Catalog

David G. Monet (US Naval Observatory Flagstaff Station)

Paper presented at the January, 1998 meeting of the AAS, Washington, DC

ABSTRACT:

USNO-A1.0 (the largest star catalog ever compiled) is particularly useful for (a) computing the celestial coordinates of unknown or un-correlated targets, and (b) removing star clutter so that such targets can be identified from a single image. By adopting catalog rather than mount-model astrometry, the accuracy of routine observations approaches that of the USNO-A1.0 catalog, about 0.25 arcseconds. The density and completeness of USNO-A1.0 means that many catalog objects will be visible in images taken with most combinations of telescopes and image sensors. The spatially culled version (USNO-SA1.0) may be adequate for applications needing fewer reference objects.

Astrometry and Photometry for Two Dwarf Carbon Stars

H.C. Harris, C.C. Dahn, R.L. Walker, C.B. Luginbuhl, A.K.B. Monet, H.H. Guetter, R.C. Stone, F.J. Vrba, D.G. Monet, and J.R. Pier

Submitted 18 January, accepted 4 March 1998 for **ApJ Vol. 502** *(20 July issue).*

ABSTRACT:

Preliminary trigonometric parallaxes and BVI photometry are presented for two dwarf carbon stars, LP765-18 (= LHS1075) and LP328-57 (= CLS96). The data are combined with the literature values for a third dwarf carbon star, G77-61 (= LHS1555). All three stars have very similar luminosities (9.6<M_V<10.0) and very similar broadband colors across the entire visual-to-near IR (BVIJHK) wavelength range. Their visual (BVI) colors differ from all known red dwarfs, subdwarfs, and white dwarfs. In the M_V versus V-I color-magnitude diagram they are approximately 2 magnitudes subluminous compared with normal disk dwarfs with solar-like metallicities, occupying a region also populated by O-rich subdwarfs with -1.5<[m/H]<-1.0. The kinematics indicate that they are members of the Galactic spheroid population. The subluminosity of all three stars is due to an as-yet-unknown combination of (undoubtedly low) metallicity, possibly enhanced helium abundance, and unusual line-blanketing in the bandpasses considered. The properties of the stars are compared with models for the production of dwarf carbon stars.

Radii and Effective Temperatures for K and M Giants and Super-giants. II.

H. M. Dyck, U.S. Naval Observatory, 3450 Massachusetts Avenue NW, Washington DC 20392-5420, meldyck@sextans.lowell.edu

G. T. van Belle, Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, MS306-388, Pasadena, California 91109, gerard@huey.jpl.nasa.gov

R. R. Thompson, Department of Physics and Astronomy, University of Wyoming, Laramie, Wyoming 82071, thompson@sparky.uwyo.edu

Submitted to **AJ***, 10 February 1998*

ABSTRACT:

We present new interferometric observations for 74 luminous red stars, made in the near infrared. We show that our 2.2æm uniform disk diameters agree with other near-infrared diameter determinations (lunar occultations and interferometers) for 22 stars measured in common with ours. From our new data we derive effective temperatures that are compared to our previous work and to comparable observations made by lunar occultations at Kitt Peak. The combined data set yields 91 luminosity II, II-III and III stars that have well-determined spectral types spanning the range from about K0 to about M8 . There are 83 stars in the sample that define an

approximately linear relationship between spectral type and effective temperature for giants with a dispersion of 192 K at each spectral type. Eight of the stars have temperatures that are roughly 750K too low for their spectral types. These stars are not known to be at the high luminosity end of the range of stars observed and are not recognized as binary stars. At present we have no explanation for their low effective temperatures. We also show that Hipparcos parallaxes combined with our angular diameters yield linear radii precise enough to see differences in the average radius between luminosity class II and luminosity class III stars.

From The Editor

Geoff Chester, Public Affairs Office

Give me enough time and I may just get the hang of this! Another issue of the *Star* is hereby presented for your perusal. I hope it will get into your hands before the next issue of the "Degenerate Star"!

It has been a hectic winter since the last issue of the *Star* came out, but, thanks to El Niño, at least we didn't have to deal with typical Washington winter commutes. I even managed to get a day's skiing in.

The USNO Christmas party was a resounding success. Over 140 people attended, and many "old-timers" came back to mingle with current employees. As a member of the Party Committee (the new guy always gets the tough jobs, right?) I had a chance to work with many of you to ensure a great event. Christine Frego deserves special recognition for all of her insight into past parties, and all of her hard work on this one.

We had a very successful showing at the AAS meeting in January, with Staff presenting several papers and posters. USNO's booth in the exhibit area received lots of traffic, and somewhere around 200 CD-ROMs of *SA1.0*, *AC 2000*, and *ACT Reference Catalogs* were handed out. One passer-by remarked "This is the most useful thing I've gotten at this conference!"

Several of us enjoyed a nice winter break to view the total solar eclipse from the Caribbean. We were welcomed back by a renegade asteroid that kept your Public Affairs Office very busy...for at least one day!

I would like to extend special thanks to all the contributors for this issue. When I sent out the call for articles, the answer was swift and almost overwhelming. Keep 'em coming!

I was pasting up the page of Christmas Party pictures when I realized that almost a quarter of 1998 has flown by. As I stepped off the gangway of the *ms Statendam* after my eclipse cruise, I half-jokingly told Leif Robinson of *Sky & Telescope* that I'd go back home and see if I could reset the Master Clock by ten days so we could do it all over again. What about it, TS?

Actually, a week of uninterrupted time (darn those pesky near-earth asteroids!) would be nice to get this newsletter done in one fell swoop. My goal for this year is to hit the stands on the astronomical season markers (excluding the cross-quarter days...) so keep up the hard work, but please be sure to write up a little something on what you're doing to share with your co-workers.

Volunteers Needed for Monday Night Tours (Still!)

Geoff Chester, Public Affairs Office

As many of you know, the Observatory hosts a tour for the general public every Monday night, except on Federal holidays. This tour is the only chance that most people have to see the workings of a modern, world-class observatory, and it is very popular. This winter we have had several capacity crowds, and the spring and summer promise to be very busy.

It takes a good deal of effort to make these tours proceed smoothly, but most of all it takes a bit of time commitment from those few staff members who like to show off their work place.

I'd like to involve more of you in this worthwhile effort. I don't ask for much, just one evening per month would be fine. If you'd like to help out, just let me know. I'll put you to work right away!

The U.S. Naval Observatory *Star*
U.S. Naval Observatory, Washington, D.C.

Superintendent
Captain Dennis Larsen

Deputy Superintendent
Commander Mark Gunzelman

Scientific Director
Dr. Ken Johnston

Editor
Geoff Chester

The Naval Observatory *Star* is published quarterly by the Public Affairs Office.

Deadline for next issue: 15 May 1998

Please address all contributions to:

Editor: Geoff Chester, USNO Star, Bldg. 1, Room Q. 762-1438.

e-mail: grc@spica.usno.navy.mil